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Hydraulic Accumulator

The invention relates to a hydraulic accumulator with the features specified in the preamble of claim 1.

Piston accumulators of this type are commercially available and are widely used in hydraulic systems in a variety of applications, for example for storing energy, emergency actuation, leaking oil compensation, volume compensation, shock absorption, pulsation damping, and the like.

Long-term behavior is of very great importance for economical and reliable use of these accumulators. In order to guarantee operating behavior which is satisfactory in this regard, it must be ensured that the oil overflow from the fluid side which normally contains hydraulic oil to the gas side is minimized over the entire service life. Current hydraulic accumulators do not meet this requirement to an adequate degree.

DE 14 50 347 A discloses a generic hydraulic accumulator with a piston which can be moved in the accumulator housing in its axial direction and which separates the gas side from the fluid side of the accumulator housing, on the periphery of the piston there being guide elements which are intended for interaction with the wall of the accumulator housing, together with least one sealing element which is offset in the axial direction to the guide elements, between the guide element which is nearest the piston side which borders the fluid side, and the sealing element which is offset in the axial direction to the gas side and which is the next one following in the axial direction, a pressure equalization channel discharging on the periphery of the piston which forms in the piston a fluid path to the fluid side, and in the pressure equalization channel there being a device which reduces its passage cross section. In the known solution the piston is formed from two piston parts which are held at a distance to one another by an energy accumulator in the form of a compression spring and which are routed within the accumulator housing along a common guide rod which forms a stop.

Due to the motion of the overall piston within the accumulator housing, there is a pressure difference between the fluid side and the intermediate space which is located on the periphery of the piston between the guide element on the fluid-side end of the piston and the sealing element which follows next in the axial direction. Due to this pressure difference, a volumetric flow into the intermediate space between the guide element and sealing element occurs over the guide element, entrained dirt particles being deposited in this way between the guide element and the piston, and due to movement of the overall piston, these particles can lead to scratches which adversely affect the system. The described pressure equalization channel eliminates the problem in that when the piston moves, no pressure difference occurs on the guide element and thus a volumetric flow which may be loaded with dirt particles is not produced. In the known solution it is possible that when the piston moves, dirt particles which may have already collected on the inside wall of the accumulator housing are run over in piston movements and in this way damage the piston.

To prevent this problem, the prior art (DE 36 19 457 A) suggested cylindrical hydraulic accumulators for hydraulic systems, consisting of an accumulator housing cylinder which is closed on its two faces and in which there is a floating piston which divides the cylinder into two spaces and which towards its seal against the inside cylinder wall on the two ends of its outside wall has one recess each, in which one respective groove-packing ring of elastomer is arranged, such that its annular groove is pointed toward the pertinent piston face; however, this measure is not sufficient for effectively deterring dirt particles. The known groove-packing rings each have in cross section a tetragonal profile sectional area which undergoes transition toward the pertinent face of the piston into a U-shaped profile cross sectional area, the U-shaped profile cross sectional area projecting radially over the tetragonal profile cross sectional area as a plain compression ring and the tetragonal profile cross sectional area in its entire width being enclosed by a support ring of a high-strength material, preferably of a carbon fiber winding bonded in resin, with an outer surface which adjoins the inside cylinder wall, sliding almost without play. In the U-profile area which is left clear, dirt can collect which can adversely affect the sealing function, and the projecting angular stripper edge of the seal, which edge is configured to be solid, is designed too stiffly for an effective sealing and stripping function.

On the basis of the most similar generic prior art in the form of a hydraulic accumulator with a pressure equalization channel in the piston, the object of the invention is to further improve the pertinent solution such that improved long-term operating behavior can be achieved. This object is achieved by a hydraulic accumulator with the features of claim 1 in its entirety.

In a hydraulic accumulator of the type referred to in the foregoing, this object is achieved as claimed in the invention in that the guide element nearest the fluid side of the piston is located closely adjacent to the fluid-side end of the piston and is formed by a guide belt with a dirt stripper lip which extends at least approximately to the end of the piston, that the guide belt has a plain compression ring which sits in an annular groove of the piston periphery with a dirt stripper lip which lengthens its radially outside annular surface on one side in the axial direction and which tapers towards its end edge, and that the piston in the peripheral area which extends from the fluid-side end to the annular groove has a section of reduced outside diameter over which the dirt stripper lip extends. In this way dirt particles which may have already collected on the inside wall of the accumulator housing are prevented with certainty from being run over when the piston moves. The stripper lip of the plain compression ring in particular also contributes to this; the stripper lip extends tapering to the outside and located in the area of the piston end extends preferably over an axial length which is somewhat larger than half the axial length of the plain compression ring.

The device which reduces the passage cross section of the pressure equalization channel ensures that only a small fluid volume is involved in the process of pressure equalization.

The device which causes a reduction of the passage cross section of the pressure equalization channel preferably reduces the passage cross section so dramatically that as a result of the narrowing of the cross section the action of a particle filter arises. Even a minimum volumetric flow through the pressure equalization channel, as arises for pressure equalization during movements, thus does not lead to transport of dirt particles into the intermediate space which is located downstream of the guide element on the periphery of the piston.

The device which reduces the passage cross section can be a choke device, for example a nozzle which is inserted into the pressure equalization channel, with a correspondingly small nozzle opening which acts as a particle filter.

Instead of a choking nozzle, as the device which narrows the cross section there can be a porous filter element which is inserted into the pressure equalization channel.

The invention will be described in detail below using one exemplary embodiment which is shown in the drawings in which

- FIG. 1 shows a cutaway longitudinal section of a piston accumulator according to one exemplary embodiment of the invention, simply the section of the accumulator housing being shown in which the piston is located, and

- FIG. 2 shows a partial longitudinal section of a piston guide element of the exemplary embodiment from FIG. 1, which section is drawn with a highly enlarged scale compared to FIG. 1, in the form of a plain compression ring with a projecting dirt stripper lip.

Of the exemplary embodiment of the hydraulic accumulator as claimed in the invention which will be described in the form of a piston accumulator, FIG. 1 shows only the section of the accumulator housing 1 in which the piston 3 is located. It forms a separating element which can move in the axial direction, i.e., along the longitudinal axis 4, between the gas side 5 and the fluid side 7 of the accumulator housing 1.

In hydraulic accumulators which are incorporated into hydraulic systems, the gas side 5 is conventionally filled with nitrogen gas, while the fluid side 7 in operation conventionally contains hydraulic oil. The sealing and guidance system which acts between the periphery of the piston 3 and the inside wall of the accumulator housing 1 and which prevents overflow of media from one piston side to the other piston side and which forms a piston guide when the piston 3 is moving, has a plurality of components which are provided on the periphery of the piston 3. In succession, in FIG. 1 in the axial direction from left to right, they are a guide element which is adjacent to the fluid-side end of the piston 3 in the form of a guide belt 9, a first piston seal 11 which is located at an axial

Claims

1. Hydraulic accumulator with a piston (3) which can be moved in the accumulator housing (1) in its axial direction and which separates the gas side (5) from the fluid side (7) of the accumulator housing (1), on the periphery of the piston there being guide elements (9, 17) which are intended for interaction with the wall of the accumulator housing (1), and at least one sealing element (15), which, offset in the axial direction to the guide elements (9, 17), is located in the peripheral section of the piston (3) which is located between the guide elements, between the guide element (17) which is nearest the piston side which borders the fluid side (7), and the sealing element (15) which is offset in the axial direction to the gas side (5) and which is the next one following in the axial direction, a pressure equalization channel (19) discharging on the periphery of the piston which forms in the piston (3) a fluid path to the fluid side (7), and in the pressure equalization channel (19) there being a device (25) which reduces its passage cross section, characterized in that the guide element nearest the fluid side (7) of the piston (3) is located closely adjacent to the fluid-side end (13) of the piston (3) and is formed by a guide belt (17) with a dirt stripper lip (35) which extends at least approximately to the end (13) of the piston (3), that the guide belt (17) has a plain compression ring (29) which sits in an annular groove (31) of the piston periphery with a dirt stripper lip (35) which lengthens its radially outside annular surface (33) on one side in the axial direction and which tapers towards its end edge (37), and that the piston (3) in the peripheral area which extends from the fluid-side end (13) to the annular groove (31) has a section (39) of reduced outside diameter over which the dirt stripper lip (35) extends.

2. The hydraulic accumulator as claimed in claim 1, wherein the device (25) which reduces the passage cross section of the pressure equalization channel (19) reduces the passage cross section so dramatically that it acts as a particle filter.

3. The hydraulic accumulator as claimed in claim 2, wherein the device which reduces the passage cross section is formed by a choke device (25).

4. The hydraulic accumulator as claimed in claim 3, wherein the choke device has a nozzle (25).

5. The hydraulic accumulator as claimed in claim 4, wherein the nozzle (25) on the piston side which borders the fluid side (7) is inserted into the mouth of the pressure equalization channel (19).

6. The hydraulic accumulator as claimed in claim 3, wherein the choke device is formed by a porous filter element which is located in the pressure equalization channel (19).

7. The hydraulic accumulator as claimed in one of claims 1 to 6, wherein the plain compression ring (29) with the dirt stripper lip (35) which is integral with it is formed from an elastomer material.